Hindawi
Scientific Programming
Volume 2022, Article ID 8056537, 7 pages
https://doi.org/10.1155/2022/8056537

Research Article

The Application of Edge Computing in the Urban Industrial Spatial Form of Macau

Haiyu Li

Faculty of Innovation and Design, City University of Macau, Macau 999078, China

Correspondence should be addressed to Haiyu Li; lihaiyuastro@stu.cdsj6.edu.mo

Received 7 April 2022; Revised 26 April 2022; Accepted 28 April 2022; Published 14 May 2022

Academic Editor: Punit Gupta

The proposal and development of edge computing provide new ideas for the management of industrial space forms in high-density cities. With the acceleration of China's urbanization process, the spatial distribution system of industries in cities is relatively complicated and is not suitable for benefit and suitability evaluation. There is still a lack of in-depth quantitative analysis and research on the industrial spatial form of Macau's high-density cities, which is restricted by factors such as shortage of land and simplification of industries. Therefore, it is necessary to explore the relationship between Macau's industrial spatial pattern and its urban spatial pattern, deepen its industrial system reform, and put forward suggestions that are more in line with the needs of urbanization. Among them, the sports, leisure, and entertainment industry account for a relatively large proportion of the industrial structure of Macau city, which is a very important part. This paper studies the aggregation and correlation of its spatial distribution through the method of nuclear density analysis and aims to provide a better basis and support for its more reasonable industrial upgrading.

1. Introduction

The research on the industrial spatial form has gradually extended to various fields of urban planning and has become an important basis for the government and relevant departments to guide the development and layout of the industry [1]. The traditional model of industrial space planning focuses on making decisions on the basis of industrial replacement and renewal from the perspective of mathematical statistics and analysis. The research on industrial space layout is relatively insufficient. Industrial space is materialized into corresponding urban space [2], which ultimately promotes urban space expansion, optimization, and upgrading of urban industrial structure and constantly promotes the renewal and restructuring of urban spatial structure. Grydehøj posits that the benefits to island spatiality encourage dense urbanization but also encourage land reclamation, which can cause island and mainland to merge, rendering the islandness of island cities invisible [3]. Regardless of the lessons from remote and sparsely populated island communities, however, more knowledge is needed concerning the effects of fixed links on island cities [4].

Macau is currently in a new stage of regional cooperation. It is proposed that Macau will cooperate with the growth of nongaming elements, enrich entertainment facilities and leisure activities, promote the development of a multiday tourism destination, and attract various types of customers by enhancing the distribution of industrial space.

At the same time, Macau's industrial spatial layout should also consider the external environment development factors and the role of local relevant departments' policy guidance [5]. Therefore, the spatial analysis conclusion based on this method needs to be combined with other analyses, so as to further test and correct it and promote the development of Macau industry more accurately and effectively. Not only that, Macau will also improve service quality, building a smart city and sustainable development as its promotion objectives. Therefore, the research on the spatial form of Macau's industrial space, especially the sports, leisure, and entertainment industry, will bring new thinking and data support for the development of Macau's industry.

2. Hidden Troubles in Macau's Industrial Structure

2.1. Gambling Industry Is Dominant. Macau's gambling rights are open, and international capital is pouring in. The gaming industry market has shown a dominant and polarized trend [6]. The gambling industry accounts for a relatively high proportion of Macau's total fiscal revenue, and due to the government's high dependence on the gambling industry, it is not active in the reform of industrial structure and has insufficient impetus to promote industries other than the gambling industry. During the epidemic period, the income of this industry plummeted, which had a huge impact on Macau's economic development.

2.2. Small- and Medium-Sized Enterprises. The key factor that constitutes the single and unbalanced industrial structure in Macau is the development of small- and medium-sized enterprises, which are not competitive and lack of adaptability to the changes in the overall industrial space and the interior of Macau, thus forming a restrictive factor for Macau's industry.

2.3. Shortage of Human Resources. The shortage and imbalance of labor supply directly affect Macau's competitiveness and the upgrading and optimization of industrial structure. The shortage of human resources before the epidemic is due to the expansion and crowding-out effect of the expansion of gambling industry and its supporting services [7]. Affected by the recent epidemic, human resources are also facing great constraints, and future demand is weakening.

2.4. Land Restriction. As is known to all, the restriction of land resources in Macau increases the production cost of the industry due to the increase in land cost and price. Macau is a microeconomy and has its own restrictions that are narrow in development space and difficult to break through. It is difficult to promote the development and renewal of industrial layout, and it is also one of the important factors that cause hidden troubles in industrial space.

3. Research on Industrial Space of Urban Spatial Form Evolution

3.1. Industrial Agglomeration in Traditional Urban Space. The reason why urban space has a greater concentration of factors of production than urban external space is that the ratio of input to output is higher in large cities. Therefore, in the traditional theory of regional development, economic growth is not evenly distributed in each space of a city but first appears in some growth points with different intensities, then spreads out through different tracks, and has different impacts on the whole industrial space [8].

3.2. Industrial Agglomeration in Modern Urban Space. Modern urban spatial industrial agglomeration theory is the spatial change between cities and regions, and the selection should focus on the combination of technology renewal and system. Under the integration of internal and external factors, it can achieve an organized and orderly development of its structure, thus promoting the spatial differentiation of industries with different functions and combining economic factors to optimize its layout. It not only refines the value function area within the city's spatial scope but also promotes the formation of the city center and subcenter, gradually expands the openness of the city's spatial structure, optimizes the city's spatial layout, and improves the city's industrial efficiency [9].

The primary form of industrial agglomeration has both random and accidental factors. The cost, innovation, and expansion advantages of agglomeration, along with the scale change of agglomeration, will strengthen the state of agglomeration and eventually form a "path locking" phenomenon of agglomeration development. The location choice of industrial agglomeration is inevitable. It is precise because one or more special factors in a certain region determine the location choice of different industries [10].

4. Research on the Industrial Space of Macau Cities and Relevant Analysis on Sports, Leisure, and Entertainment Industry

4.1. Research on the Industrial Space of Macau City by Using the Nuclear Density Analysis Method. Using GIS to analyze urban space can adapt to the scope of different industries, divide the reasonable areas of different industries, and update and adjust the existing urban space and land use. Each POI point can be regarded as a functional unit, and the higher the density of POI is, the more urban functions in the area are gathered [11]. Therefore, the nuclear density analysis of POI in the study area can identify the location of the city center [12], analyze the center system within the city, and also can analyze the concentration degree of relevant POI to guide its layout planning in the area.

As shown in Figure 1, Macau Peninsula has the highest concentration of service facilities in the central urban area, followed by Taipa, which is divided into two clusters with relatively weak road links.

The layout of Macau's service facilities is a multicenter model, with the density decreasing from each central city district to the outer circle, with a finger-like extension trend in the urban periphery.

There are some deficiencies in the classification of POI data because the gaming industry is one of the pillar industries in Macau. There is no very detailed classification in the data. Most of them are covered in the sports leisure service data, which is relatively rough. At present, only the aggregation degree and distribution are analyzed, lacking accuracy.

4.2. Sports Leisure and Entertainment Industry-Related Analysis. Based on the data, this paper makes a spatial analysis of the distribution of Macau's sports, leisure, and entertainment industry, to judge the spatial distribution characteristics, spatial agglomeration pattern, and layout

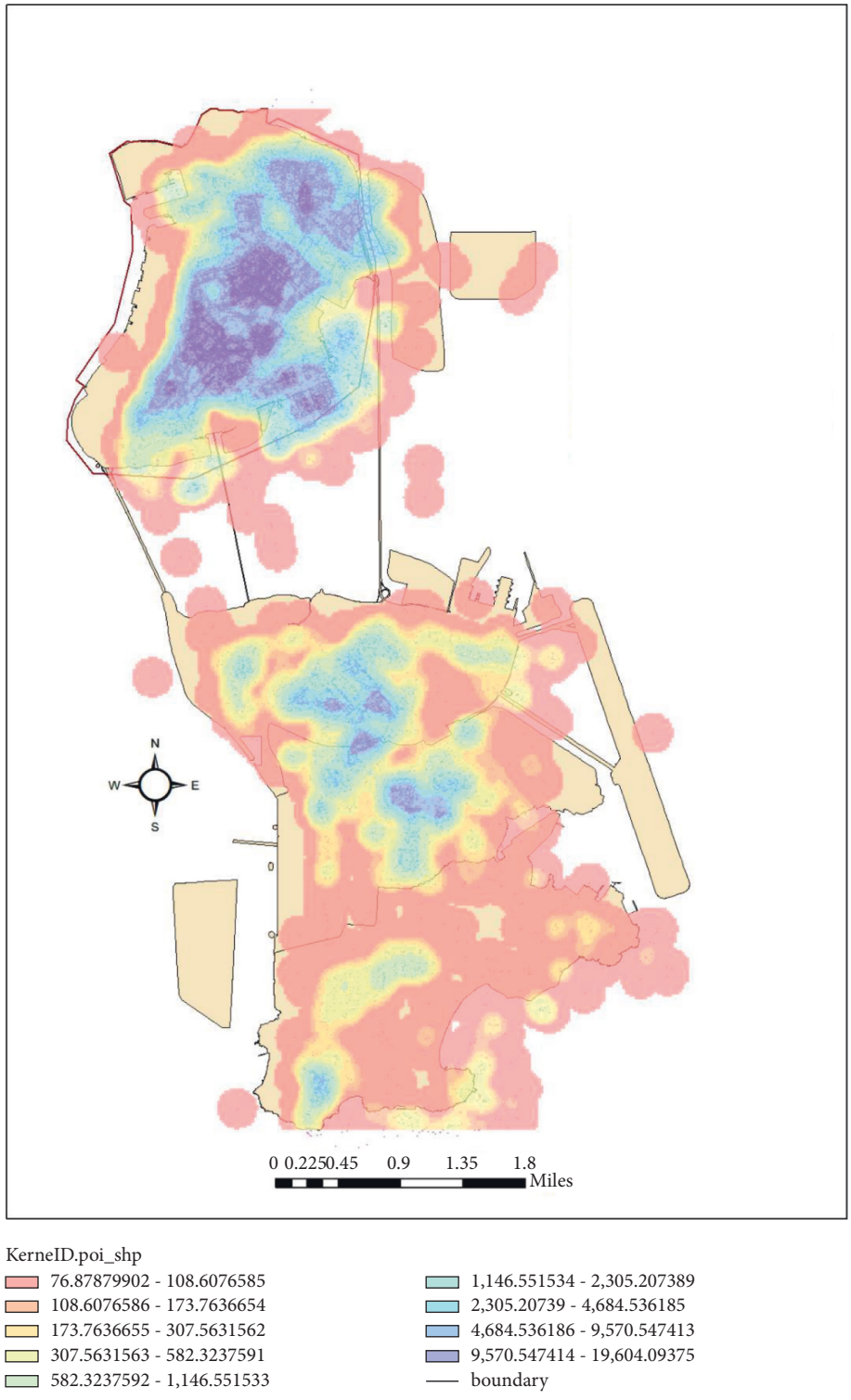

Figure 1: The nuclear density analysis of POI in the study area.

influencing factors of Macau's industry and provide relevant theoretical and data support for the upgrading of Macau's industry.

As shown in Figure 2, it can be seen that in Macau's sports and leisure industry, there are vacation and recuperation places. The average value of LNG in the resort is maintained at about 113.55, with a maximum value of 113.59, a minimum value of 113.54, and a standard deviation of about 0.008. At the same time, it can be seen that the skewness value is 0.05 greater than 0, so it is right skewness

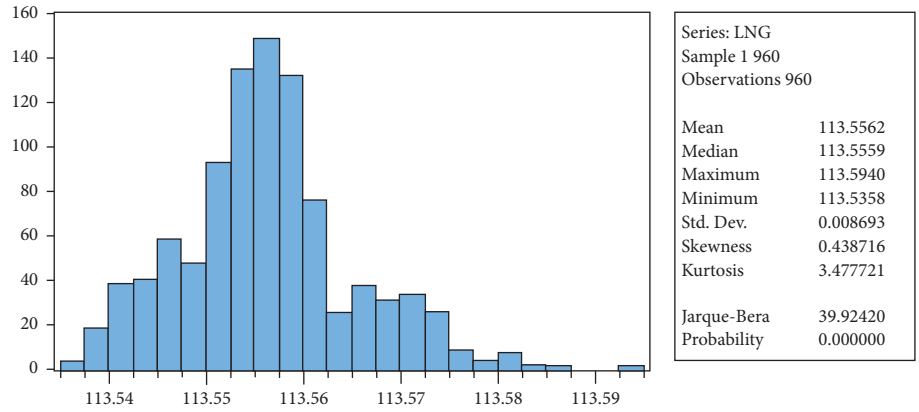

Figure 2: Analysis of LNG data in Macau sports, leisure, and entertainment industry.

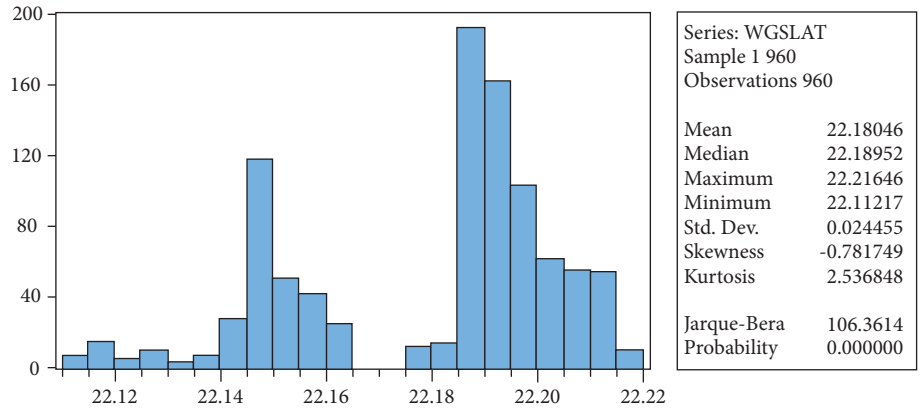

Figure 3: Analysis of WGSLAT data in Macau sports, leisure, and entertainment industry.

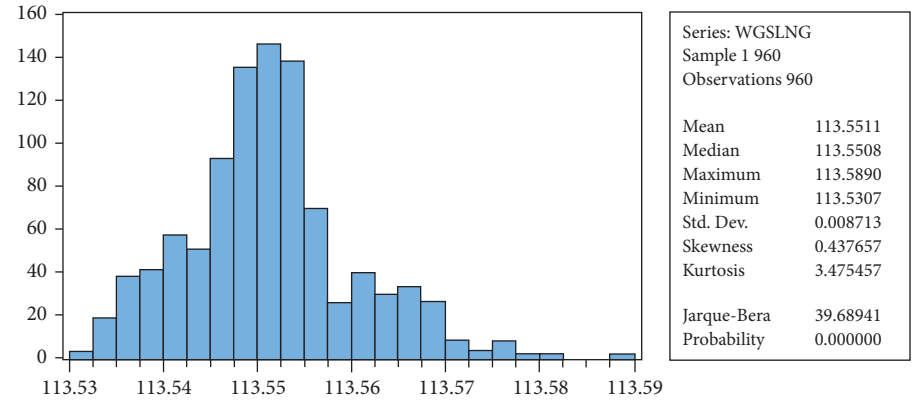

Figure 4: Analysis of WGSLNG data in Macau sports, leisure, and entertainment industry.

distribution, and the kurtosis value is 3.477 greater than 0, so it presents sharp peak distribution, which generally belongs to right skewness concentration distribution.

As can be seen from Figure 3, in Macau's sports and leisure industry, the average value of WGSLAT is maintained at about 22.18, with a maximum value of 22.22, a minimum value of 22.11, and a standard deviation of about 0.024. At the same time, it can be seen that the skewness value is −0.78 less than 0, so it is left skewness distribution, and the kurtosis value is 2.5368 greater than 0, so it presents sharp peak distribution, which generally belongs to left skewness concentration distribution.

As can be shown in Figure 4, the average value of WGSLNG in Macau's sports and leisure industry is maintained at about 113.5511, with a maximum value of 113.589, a minimum value of 113.531, and a standard deviation of about 0.008. At the same time, it can be seen that the skewness value of WGSLNG is 0.438 greater than 0, so it is right skewness distribution, and the kurtosis value is 3.475 greater than 0, so it presents sharp peak distribution, which

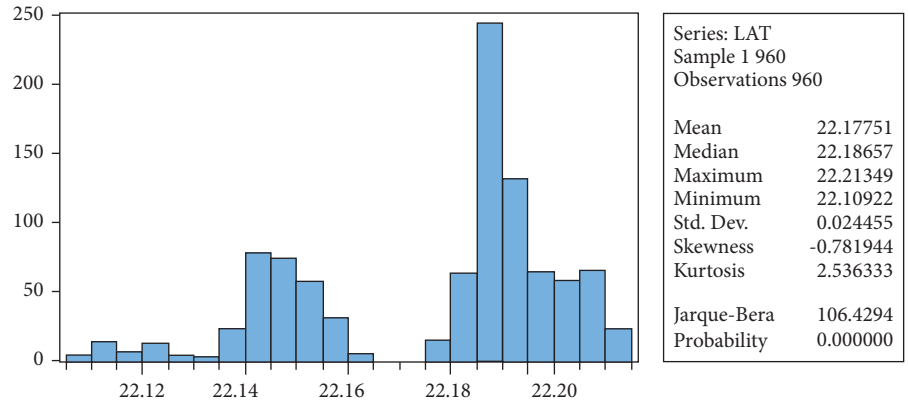

Figure 5: Analysis of LAT data in Macau sports, leisure, and entertainment industry.

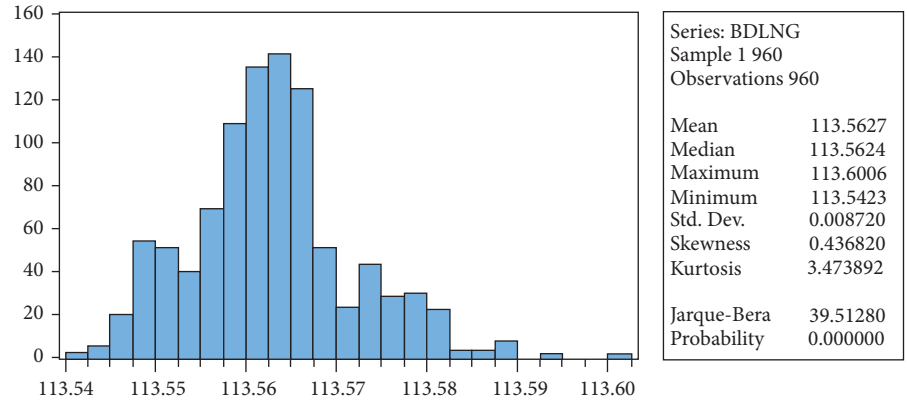

Figure 6: Analysis of BDLNG data in Macau sports, leisure, and entertainment industry.

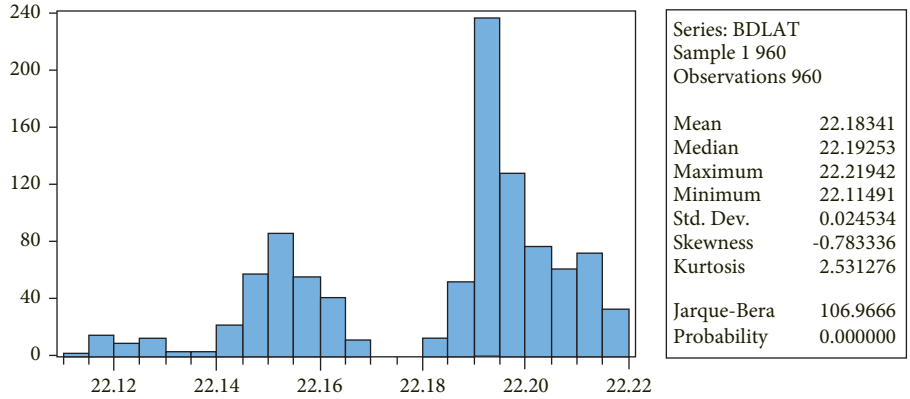

Figure 7: Analysis of BDLAT data in Macau sports, leisure, and entertainment industry.

generally belongs to right skewness concentration distribution.

As can be shown in Figure 5, the average value of LAT in Macau's sports and leisure industry is maintained at about 22.178, with a maximum value of 22.213, a minimum value of 22.109, and a standard deviation of about 0.0245. At the same time, it can be seen that the skewness value is −0.782 less than 0, so it is a left skewness distribution, and the kurtosis value is 2.536 greater than 0, so it presents a sharp peak distribution, which generally belongs to a left skewness concentration distribution feature.

As can be shown in Figure 6, in Macau's sports and leisure industry, the average value of BDLNG is maintained at about 113.5627, with a maximum value of 113.600, a minimum value of 113.542, and a standard deviation of about 0.009. At the same time, it can be seen that the skewness value is 0.436820 greater than 0, so it is right skewness distribution, and the kurtosis value is 3.473892

Correlation							
	WGSLNG	WGSLAT	LNG	LAT	BDLNG	BDLAT	
WGSLNG	1.000000	-0.645031	1.000000	-0.645399	1.000000	-0.648457	
WGSLAT	-0.645031	1.000000	-0.644982	1.000000	-0.644819	0.999989	
LNG	1.000000	-0.644982	1.000000	-0.645351	0.999999	-0.648409	
LAT	-0.645399	1.000000	-0.645351	1.000000	-0.645188	0.999991	
BDLNG	1.000000	-0.644819	0.999999	-0.645188	1.000000	0.648246	
BDLAT	-0.648457	0.999989	-0.648409	0.999991	-0.648246	1.000000	

Figure 8: Correlation analysis of Macau's sports and leisure industry.

greater than 0, so it presents sharp peak distribution, which generally belongs to right skewness concentration distribution.

As shown in Figure 7, in Macau's sports and leisure industry, the average value of BDLAT is maintained at about 22.18341, with a maximum value of 22.219, a minimum value of 22.115, and a standard deviation of about 0.024534. At the same time, it can be seen that the skewness value is −0.783 less than 0, so it is the left skewness distribution, and the kurtosis value is 2.531 greater than 0, so it presents sharp peak distribution, which generally belongs to the left skewness concentration distribution feature.

As can be shown in Figure 8, in Macau's sports and leisure industry, the correlation coefficient between WGSLNG and WGSLAT is 0.645, the correlation coefficient between WGSLNG and BDLAT is 0.648, the correlation coefficient between BDLNG and BDLAT is 0.648, the correlation coefficient between BDLNG and LAT is 0.645, and the correlation coefficient between LNG and WGSLAT is 0.645. The correlation coefficient is 0.644982, and the correlation coefficient between WGSLNG and LAT is 0.645. According to the distribution of independent variables and the fluctuation, the stability of the distribution of sports leisure venues can be seen.

5. Conclusion and Discussion

Industrial space form is the core content of industrial planning. Through the analysis, it is found that the distribution of the sports and leisure industry in Macau above the research area shows the characteristics of "small concentration and large dispersion." The proposal and development of edge computing provide new ideas for the management of industrial space forms in high-density cities. With the acceleration of China's urbanization process, the spatial distribution system of industries in cities is relatively complicated and is not suitable for benefit and suitability evaluation. According to the analysis chart of Macau's industrial nuclear density, from the perspective of the city domain, the regional system presents a four-center multipoint layout, with the center mainly being the central urban area with a high concentration of service facilities and the multipoint mainly being the peripheral service centers.

In its correlation analysis, the right-sided concentrated distribution refers to the distribution of resorts, sanatoriums, and leisure entertainment in Macau's sports and leisure industry resorts. The variable is the distance from the city center, which obeys the right-sided concentrated distribution. Then, it indicates that the location of this kind of industry as a whole is close to the city center and densely distributed, with sports and leisure services; Sports venues: if the sports venues obey the left-hand centralized distribution, then the location of such industries is relatively far away from the city center and relatively scattered. In the later upgrade of Macao sports leisure industry space, if we can do regional division and form a central development in key areas, it will be more conducive to the increase of industrial income and promote other industries in the relevant area.

However, there are still some limitations of this research. Most of the choices of different types of units and spatial weights based on different industry analyses are still based on experience. Different divisions and choices will affect the conclusions of the spatial analysis to a certain extent and then affect the industrial spatial layout planning scheme. At the same time, Macau's industrial spatial layout should also consider the external environment development factors and the role of local relevant departments' policy guidance [5]. Specific geographical, political, and socioeconomic contexts should be considered in investigations of urban fragmentation. Macau's island status has had a variety of important consequences on the city's urban fragmentation. Therefore, the spatial analysis conclusion based on this method needs to be combined with other analyses, to further test and correct it and promote the development of the Macau industry more accurately and effectively.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The author declares that there are no conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

[1] Z. Renkang and X. Zhengning, "Industry momentum mechanism of urban spatial restructuring," *Journal of Southwest University For Nationalities*, vol. 31, no. 4, pp. 146–150, 2010.

[2] Y. Li, Y. Zhang, and J. Xu, "Research on urban and rural industrial space layout planning based on the technique of esda: a case study of rudong county," *Modern Urban Research*, vol. 8, pp. 113–119, 2014.

[3] A. Grydehøj, "Island city formation and urban island studies," *Area*, vol. 47, no. 4, pp. 429–435, 2015a.

[4] A. Leung, M. Tanko, M. Burke, and C. S. Shui, "'Bridges, tunnels, and ferries: connectivity, transport, and the future of Hong Kong's outlying islands," *Island Studies Journal*, vol. 12, no. 2, pp. 61–82, 2017.

[5] F. Y. Xu and Y. Y. Cao, "Research on the agglomeration characteristics of service industry in guangdong Hong Kong Macao greater bay area and its influential factors," *Journal of Finance and Economics Theory*, vol. 5, pp. 53–63, 2019.

[6] J. Chunli, "Analysis of gaming EnterprisesBased on the perspective of industrial diversification in Macao," *Studies on Hong Kong and Macao*, vol. 2, pp. 121–132, 2015.

[7] L. Yanjun and L. Chenggu, "Regulation model and mechanism of urbanization response to the industrial structure evolvement in northeast China," *Acta Geographica Sinica*, vol. 64, no. 2, pp. 153–166, 2009.

[8] F. Cao, H. Xing, D. Hou, H. Xu, M. E. N. G. Yuan, and X. Guo, "Research on identification and spatial patterns of commercial centers in beijing based on POI data," *Geomatics World*, vol. 26, no. 1, pp. 66–71, 2019.

[9] Yi Liu, L. Chen, Z. Liu, and Y. Chen, "Exploring spatial agglomeration patterns of the leisure industries based on the Co-location mining model," *Tourism Tribune*, vol. 37, no. 2, pp. 94–104, 2022.

[10] J. Duan and L. Zhu, "Analysis of creative industry parks' spatial evolution, its agglomeration characteristics and influence factors: a case study of shenzhen," *Modern Urban Research*, vol. 10, pp. 76–82, 2015.

[11] S. Wang and J Li, "Ana lysis and visualization of POI distribution density based on urban network space," *Urban Geotechnical Investigation & Surveying*, vol. 1, pp. 21–25, 2015.

[12] Ge Shi, N. Jiang, and L. Yao, "Study on the identification of urban center system based on GIS and POI A case study of shanghai," *Modern Surveying and Mapping*, vol. 40, no. 6, pp. 27–30, 2017.